

Making Sense of Proportions

In the following comparison problems, you have information about the relationship between quantities, but one or more specific values are unknown.

- **Calculators** Calculators are on sale at a price of \$1,000 for 20. How many can be purchased for \$1,250?
- **Similar Figures** The scale factor relating two similar figures is 2. One side of the larger figure is 10 centimeters long. How long is the corresponding side of the smaller figure?
- **Country Music** Country music is the primary format of 20% of American radio stations. There are about 10,600 radio stations in the United States. About how many stations focus on country music?
- **Doctors** Among American doctors, males outnumber females by a ratio of 15 to 4. If about 450,000 doctors are males, about how many are females?

Each of these problems can be solved in several ways. You will learn specific ways to set up ratios for problems like this and find missing values.



4.1

Setting Up and Solving Proportions

There are many ways to solve problems such as the ones on the previous page. One standard way is to create two ratios to represent the information in the problem. Then set these two ratios equal to each other to form a proportion. A **proportion** is an equation that states two ratios are equal.

For example, in the problem about doctors, you have enough information to write one ratio. Then write a proportion to find the missing quantity. There are four different ways to write a proportion representing the data in the problem.

Write the known ratio of male to female doctors. Complete the proportion with the ratio of actual numbers of doctors.

$$\frac{15 \text{ (male)}}{4 \text{ (female)}} = \frac{450,000 \text{ males}}{x \text{ females}}$$

Write a ratio of male to male data. Complete the proportion with female to female data.

$$\frac{15 \text{ (male)}}{450,000 \text{ males}} = \frac{4 \text{ (female)}}{x \text{ females}}$$

Write the known ratio of female to male doctors. Complete the proportion with the ratio of actual numbers of doctors.

$$\frac{4 \text{ (female)}}{15 \text{ (male)}} = \frac{x \text{ females}}{450,000 \text{ males}}$$

Write a different ratio of male to male data. Complete the proportion with female to female data.

$$\frac{450,000 \text{ males}}{15 \text{ (male)}} = \frac{x \text{ females}}{4 \text{ (female)}}$$

Using your knowledge of equivalent ratios, you can now find the number of female doctors from any one of these proportions.

Does any arrangement seem easier than the others?

Getting Ready for Problem 4.1

Analyze the “Similar Figures” problem in the introduction.

The scale factor relating two similar figures is 2. One side of the larger figure is 10 centimeters long. How long is the corresponding side of the smaller figure?

- The scale factor means that the lengths of the sides of the larger figure are 2 times the lengths of the sides of the smaller. What is the ratio of the side lengths of the smaller figure to those of the larger figure?
- Write a proportion to represent the information in the problem.
- Solve your proportion to find the length of the corresponding side of the smaller figure.

Problem 4.1 Setting Up and Solving Proportions

- A.** Figure out whether each student’s thinking about each line in the following problem is correct. Explain.

Dogs outnumber cats in an area by a ratio of 9 to 8. There are 180 dogs in the area. How many cats are there?

Adrianna’s Work:

$$\frac{9 \text{ dogs}}{8 \text{ cats}} = \frac{180 \text{ dogs}}{x \text{ cats}}$$

$$\frac{9}{8} \times \frac{20}{20} = \frac{180}{160}$$

$$\frac{180}{160} = \frac{180}{x}$$

$$x = 160$$

1. Why did Adrianna multiply by $\frac{20}{20}$? How did she find what to multiply by?
2. What does this proportion tell you about the denominators? Why?
3. Is the answer correct? Explain.

Joey’s Work:

$$\frac{8 \text{ cats}}{9 \text{ dogs}} = \frac{x \text{ cats}}{180 \text{ dogs}}$$

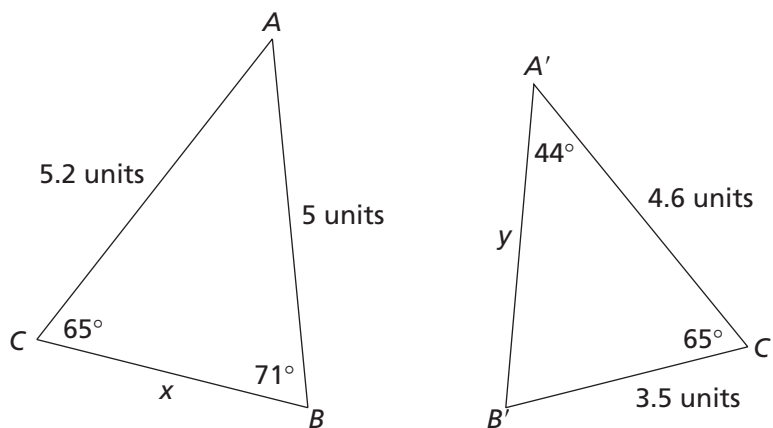
$$\frac{8}{9} = \frac{80}{90} = \frac{160}{180}$$

There are 160 cats.

4. What strategy did Joey use?
5. Why can he make this claim?

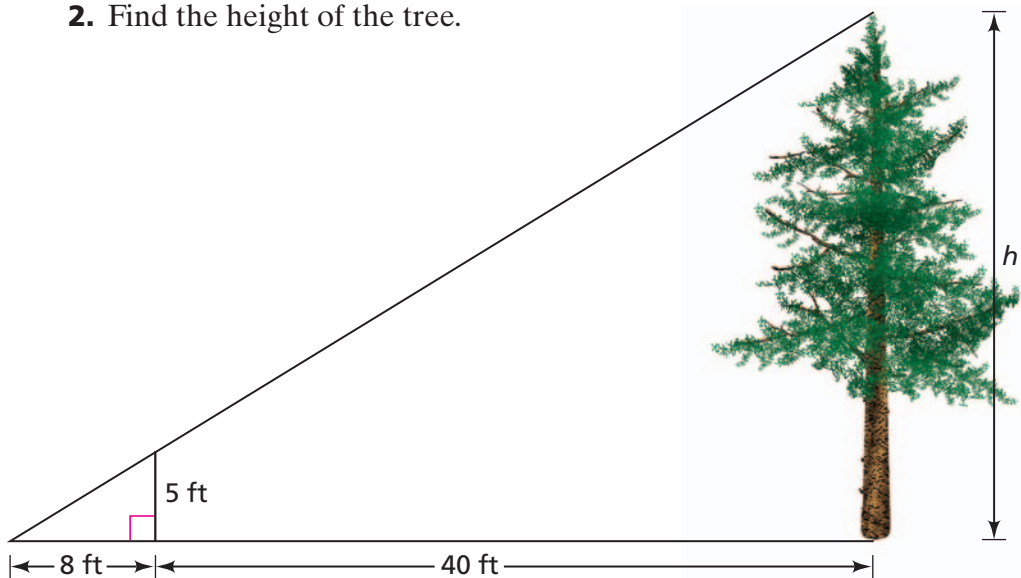
- B. 1.** Calculators are on sale at a price of \$1,000 for 20. How many can be purchased for \$1,250? Write and solve a proportion that represents the problem. Explain.
- 2.** Country music is the primary format of 20% of American radio stations. There are about 10,600 radio stations in the United States. About how many stations focus on country music?
- C.** Use the reasoning you applied in Question B to solve these proportions for the variable x . Explain.
- 1.** $\frac{8}{5} = \frac{32}{x}$ **2.** $\frac{7}{12} = \frac{x}{9}$ **3.** $\frac{25}{x} = \frac{5}{7}$ **4.** $\frac{x}{3} = \frac{8}{9}$
- D.** Use proportions to find the missing lengths in the following similar shapes.

1.



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2. Find the height of the tree.



ACE Homework starts on page 55.